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Economic analysis of flat-plate solar collectors (FPSCs): A solution to the unemployment problem in the city of Eskisehir

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ABSTRACT

This study performs a regional economic analysis of solar energy systems in Eskisehir, Turkey that focuses on production and utilization of FPSCs. The data is obtained from a locally conducted survey and used for practical estimations. Both, the survey findings and the theoretical predictions give close results and they sustain each other. Under the condition of free market considering profit maximization, to produce 30 FPSCs per day in optimum conditions, 30 workers would be employed per shift. If a company can meet the market demand, 450,000,000 Turkish Liras (TL) (1$=2.85TL with current prices) of revenue will be earned from the production of 300,000 FPSCs in 30 years are displayed. On the other hand, this renewable energy system has some costs. However, once it has been set up, the system will produce many ecological advantages that more than offset its costs. These effects benefit both the local region in which the system is established and the environment on a global scale. In addition, the process of collecting and utilizing solar energy can be used together with recycling systems to generate advantages for a local economy and can also benefit the global economy by solving unemployment problems by creating employment opportunities.

Contents

1. Introduction

Turkey has some energy problems both in the local and in the whole of its geography. These energy problems can be solved by using renewable energy resources. Today, energy that is produced

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and utilized in an environmentally friendly manner – such as solar energy collected by FPSCs – is particularly valuable. Indeed, solar energy systems are ecologically sound because they produce significant energy savings compared with conventional energy systems. In particular, developing countries such as Turkey need these energy systems. In Turkey, the annual average total insolation duration is 2623 h and the average annual solar radiation is 1303 kW h/m^2 per year. This number corresponds to the potential production of 304,707 million kW h annually. Turkey's total primary energy consumption was around 127 billion kW h in 2010, and 89.3% of its energy consumption was supplied by fossil fuels [1]. Thus, 24% of Turkey's energy consumption could be supplied by solar energy. But how? What can be done for both locally and centrally in the country? Which lessons can be learned for entrepreneurships? The answers to these questions are the key factors on Turkey's transition to renewable energy systems, and the subject of this study.

Turkey should develop both national and regional strategies to effectively use renewable energy resources. Solar energy is an example of an alternative resource. Solar energy systems are used to obtain heat energy from solar insolation through a recycling process. The benefits of those systems that use photovoltaic solar cells to recycle solar energy and directly converting it into electrical energy are generally accepted worldwide; in fact, applications of these systems have previously been implemented in developed countries (for example U.S.), as Bardhan et al. [2] has stated. Turkey has the potential to collect copious amounts of solar energy. Both Kaya [3] and Çetin & Eğrican [4], notice that Turkey has a potential in solar energy economics. According to Kaya; this potential can be an alternative energy resource instead of using the limited reserve of oil and natural gas. The Turkish Government should support cost-effective renewable energy applications by encouraging the private sector. Due to Çetin & Eğrican; the energy needed can be supplied quickly by producing solar energy systems domestically in Turkish markets. They recommend an economic policy in which government, universities and private sectors should come together and solve the energy problem of Turkey. Currently, it is necessary to resolve the problem of increased energy deficits related to obtaining electrical energy from solar energy and using it in appropriate circumstances is crucial. Because of their economic and ecological advantages, renewable energy systems often attract global attention. Examples of country-specific studies regarding solar energy systems include [5–11] and [12]. In this regard, Stritih et al. [13], make a comparison between Turkey and Slovenia in terms of solar energy potentials and, they state that current applications are limited to solar domestic hot water utilization even though the solar energy is abundant in both of the countries.

In particular, some studies that are related to solar energy systems and that address policy, markets and/or employment include [14,15] and [16]. Additionally, there are several studies related to solar energy systems and the relevant policies that may be applied. In their above-mentioned study Çetin & Eğrican [4] emphasized that solar energy is an indispensable resource for many countries across the globe, and they showed that the use of this renewable energy resource in Turkey might produce economically positive effects on employment. In addition, these authors also argued that this concept could succeed with the help of appropriate government tariff policies encouraging the production and consumption of solar energy. According to a report from the Union of Chambers of Turkish Engineers and Architects (UCTEA) [1], Turkey's foreign energy dependency has grown because of the government's privatization policies, which decreases the effectiveness of public utilities and leads to higher energy prices. As a social consequence of this situation, the energy consumption of low-income families is limited to the energy available as a result of local conditions. According to data from the UCTEA [1], Turkey is faced with problems of foreign energy dependency, as foreign countries are responsible for more than 70% of the local consumption of primary energy and are responsible for 60% of Turkey's electricity production. Solving this problem is only possible by decreasing foreign energy purchasing receipts, which reached $65 billion in 2012. Reducing these purchases might result in the development of energy production that is cheap, continuous, reliable and sustainable. In addition, to minimize the harm that energy investments often inflict on the environment, the need to design and apply basic policies and programs to foster the local production of sustainable systems and equipment is emphasized in the [1]'s reports.

In addition to the aforementioned global studies, the literature also features regional studies, such as those by [17–20] and [21]. Benli [22] starts from a global perspective and continues with a regional case. He says that, Turkey has the highest energy potential among European countries. Turkey knows this potential and tries to maximize it. If this energy policy is successful Turkey will be one of the leading European countries after Spain in solar power investment. He recommends the government should encourage the use of solar water heating systems in western, eastern and southeastern regions of Turkey. For the example of locational research, like in our study, Karaca and Başçiftçi [23], chose one of our neighboring cities; Konya, which is located southeast of Eskisehir and they show that a solar energy system can supply a household's energy needs, therefore producers and scientists should give importance for researching and developing solar energy technologies.

There are very few studies concentrating on FPSCs. Ozsabuncuoglu [24], makes an economic analysis of FPSCs in general. Bulut [25], measures the solar radiation quantity for seven provinces which are located Southern Anatolia. To this end, he states that the highest solar energy potential is this region and the solar energy systems designers need to consider this important fact. Our search of the related literature revealed studies that are close to our minds, such as Li et al. [18], who studied the economics of home solar water systems in Dezhou, China. In addition, they proposed a transition to green energy systems from the local region to the entire country. The present study examines regional solar energy use in Eskisehir and throughout Turkey. In this study, we explore how to practically establish solar energy systems as an alternative energy source, and we address the extent to which these systems contribute to economic utility and regional employment. By adopting the practical recommendations emphasized in this work, the residents of Eskisehir should be able to enjoy both high-quality employment opportunities and the positive externalities that accompany overcoming the problems of environmental pollution caused by the consumption of conventional energy.

It is well known that FPSCs are one of the basic solar energy systems. However, it is important to note that there are also certain technological, economic, political and social obstacles in developing countries related to solar energy systems [26]. Although these systems have certain associated costs (such as those related to installation, credits, annual maintenance and repairs), these systems produce many ecological advantages that exceed their costs after their installation. These advantages include long-term fuel savings and exemptions from tax payments for the energy produced, which the advantages benefit the region and the nation.

FPSCs can be used efficiently in Eskisehir eight months of the year because of its regional advantages: Eskisehir is geographically positioned to receive high-quality solar insolation and is characterized by low levels of moisture. The building patterns in Eskisehir offer insights into the solar energy potential of the city. In 2010, Turkey met 32% of its energy demand with natural gas [27]. Classifications of the distribution are for four months in Eskisehir